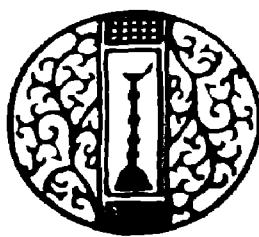


SCIENCE — A SUPRANATIONAL ACTIVITY

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ANDREW HUXLEY



INDIAN COUNCIL FOR CULTURAL RELATIONS

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Jacket Design : Kanti Roy

Published by
Veena Sikri
Director-General
Indian Council for Cultural Relations
Azad Bhavan
New Delhi-110 002

Printed in India at
VAP Enterprises
H-24, Green Park Extension
New Delhi-110 016

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Welcome Address

Sir Andrew Huxley, scholars, scientists, ladies and gentlemen :

It gives me immense pleasure to welcome Sir Andrew Huxley for the 25th Maulana Azad Memorial Lecture in the year when we are celebrating the centenary of Maulana Abul Kalam Azad's birth. We have had eminent people delivering these lectures. The first was delivered by Pandit Jawaharlal Nehru. Then we had Arnold Toynbee, Lord Attlee, Sir C. V. Raman, Lord Butler, the scientists

Linus Pauling, Dr. Kothari, Dorothy Hodgkin and other eminent people. The last lecture was delivered by one of our great freedom fighters, Shrimati Aruna Asaf Ali.

In this series we were keen to have Sir Andrew to deliver the lecture not only because he is a Nobel laureate and comes from the eminent Huxley family but because of his humility and his attitude towards humanity as a whole. I understand he is going to talk today on 'Science — a Supranational Activity'. That is in consonance with the thought of science everywhere. The oneness of humanity is a thought we come across from very old times. The Rig Veda tells us : "All noble thoughts should come from all over the world". And science cannot be and should not be bound to the national boundaries. And this is what Maulana Abul Kalam Azad also emphasized from time to time. In 1952 he said, while opening an exhibition of Soviet fine arts :

"The paramount need of the modern age is a closer understanding between the peoples of different countries of the world."

Again he said— and this is also a warning:

"Science possesses in many senses such tremendous powers of destruction that men of different races and countries must learn to live in friendship and amity if they are to live at all."

So the subject chosen by Sir Andrew falls in line with the dominant thought of Maulana Abul Kalam Azad because this was a subject which he referred to time and again—the fact that science should serve humanity and should not result in destruction.

In 1953, again, Maulana said :

“Greater knowledge of germs and bacteria promises mastery over disease and suffering but such knowledge is often being employed to develop their use as weapons in biological war.”

Consistently he warned against science being used for narrow national ends or for suppressing others.

That is why, I think, it is very appropriate that Sir Andrew has chosen this subject. And this was also the theme often touched upon by the person who delivered the first Azad Memorial Lecture, Pandit Jawaharlal Nehru. He said:

“Science and technology have freed humanity from many of its burdens and given us this new perspective and great power. This power can be used for the good of all if wisdom governs our actions but if the world is mad or foolish it can destroy itself just when great advance and triumphs are almost within its grasp.”

Of course, Jawaharlal Nehru always talked about the oneness of humanity. It is very appropriate that we have a person of the eminence of Sir Andrew Huxley today to remind the world about the ultimate objective of science

which is the welfare of humankind. I am sure all of us will benefit by his words of wisdom born out of his life-long study of science. And I hope these words will spread beyond this Indian subcontinent and be heard by humanity so that the world lives and science continues to work on the lines envisaged by our forefathers a few thousand years back in the words: “Shastra puryojanam tatv darshanam” — “the objective of science is to understand the truth” — the truth of the oneness of humanity which cannot be divided up on grounds of race, religion, caste or colour.

I am very happy that Sir Andrew accepted the invitation of ICCR and has kindly come here. I now request him to deliver his lecture or message that science is meant for all the people.

Thank you.

Dr. Shanker Dayal Sharma
Vice-President of India
President, ICCR

Science — A Supranational Activity

Thank you very much, Vice-President, for your kind words. Ladies and Gentlemen: I feel it a great honour to have been invited to give this lecture in memory of Maulana Abul Kalam Azad, and particularly to be asked to follow such a very distinguished line of speakers in previous years.

First, let me pay my own small tribute to Abul Kalam Azad, which I very readily do although he was a prominent freedom fighter against my own Government and al-

though probably all of you know a great deal more about him than I do. It was he who set the path of education in independent India, and education is probably the strongest force towards improving relationships between peoples and nations. Further, I respect him greatly for the fact that he did his best to resist and to reduce tensions between religious communities — I was going to say despite his being a learned and devout Muslim, but would rather say that it was probably because he was a truly and sincerely religious man that he realized the dangers and horrors of religious strife. And for this reason it is very appropriate that the stated purpose of these lectures is to contribute towards the promotion of understanding among the peoples of the world.

My first reaction to the invitation was that I have rather little experience in international affairs and that I have nothing to add on this topic. But on reflection it occurred to me that science is probably the field of human activity in which there is less misunderstanding between peoples or nations of the world than any other. So perhaps this internationalism of science may act as an example to other fields of human activity.

Ideally, national boundaries are not recognised in science and one could indeed wish that this was so in other human activities. But do not suppose^{*} that I imagine that conflict between peoples could be resolved easily by imitating science. Most of the causes of international

tension hardly exist in science: the desire for power over other people, the desire to increase one's territory, or the desire to increase the wealth and well-being of one's own people. And insofar as such factors may exist and may influence science, the ideal of science is not being achieved. Nations do acquire some prestige from success in science and applied science does increase wealth; these are factors that tend to produce international antagonisms within science. But I chose the word "supranational" in my title because the word "international" often implies interaction between nations as such, and science is not like that. Science is done mostly by individuals or groups who publish their work so as to be read and judged by similar groups anywhere in the world. It is not published by or on behalf of the nation in which the work was done.

In other contexts, peoples or nations readily unite only when there is a common enemy. In a limited sense, this is true of science. For example, my grandfather, Thomas Henry Huxley, defender of Darwin, gave in the year 1870 his presidential address to the British Association for the Advancement of Science, and he spoke of the "improvers of natural knowledge", that is to say scientists, as being at war with "ignorance, the great enemy of all", an analogy that implies uniting in war against a common enemy. Well, I am a more peaceable man than my grandfather was, and I think of the advance of science not in terms of war but as exploration of new territory. But

whatever way you look at it, scientists of all nations do combine, working in a common cause, pitted against something quite impersonal.

Most of what I shall say in fact concerns ways in which this ideal of co-operation between scientists is not always achieved. In this respect, all scientists, I think, would admit to some special pleasure when a compatriot wins an international prize. But there are very few, if any, who would do anything to hinder the work of a competitor for such a prize because he belongs to another country.

In this context as in many others, it is important to distinguish between pure science and applied science. Many scientists deny that such a distinction exists, but to my mind it does, though it is not a sharp distinction. There are many respects in which pure science, the search for knowledge, and applied science, the use of this knowledge for specific purposes, are very similar : the methods are the same; very often the same person does work of both kinds; in both cases the criterion is whether one's ideas agree with observation. But there is a difference in motive. As I said, the pure scientist's motive is to improve our understanding of nature while the motive of the applied scientist is to make a machine or to achieve some improvement in health or in some other aspect of the human condition. And the ideal of supranationalism becomes more difficult to achieve as one moves along this spectrum from pure to applied, since the national

advantage from science becomes greater.

This ideal also becomes more difficult as one moves from natural science into the borderland between science and the humanities: archaeology, pre-history, history itself, where interpretations of events may have strong implications for the prestige and the self-respect of nations. A few years ago, the Historical Associations of the United States and of Great Britain carried out a cooperative study of the way in which schools in the two countries taught about the War of Independence of America from Britain at the end of the 18th century. They published their results in a book entitled "The Historian's Contribution to Anglo-American Misunderstanding", citing cases where the interpretation of particular events was different in the two countries, being adjusted so as to fortify myths on which national self-respect depends.

Even in pure science, where the barriers are smallest, there are still barriers to be overcome. They usually are overcome, but I think, by way of warning, I should spend much of this lecture mentioning what seem to me to be the principal ones.

First of all, language. At different times different languages have been used internationally in science — in classical times Greek, in medieval times Arabic, in early modern times up to the 17th century Latin; and then in the 19th century with the great development of science, English and French but most of all German became the

important languages. And it is commonly said that in recent decades the international language of science has come to be broken English. In using those words, I mean no disrespect at all: I often find that the English spoken at scientific meetings by non-native English speakers is easier to understand than that of Englishmen who speak fast and do not pay attention to the acoustics of the place where they are speaking. And I remember an occasion when with a German-speaking friend I attended a meeting of German-speaking physiologists in Switzerland and the paper that I found easiest to understand was given by an Italian. His German was much more intelligible to me than that of native Germans, but it caused great amusement to my host.

Up to the time of World War II, German was the scientific language of many countries whose own language was not one of the international languages of science. For example, the Scandinavian countries, Sweden, Denmark, Norway and Iceland, had a journal in my own branch of science entitled “Skandinavisches Archiv für Physiologie”, and the papers were all or nearly all in German. But after the War, that journal changed its name to “Acta Physiologica Scandinavica” and all its articles are now in English. In the same way, in Japan before the War, German was the second language for academics, who published their work mostly in German in German-language journals published in Europe. Now they publish

their work almost exclusively in English in journals published in Japan.

French scientists held out against this demise of their own language as an important scientific language longer than Germans did. I remember being greatly struck in 1971 when the International Congress of Physiology was held in Munich and one of the things that the President of the Congress said in his opening address was “The language of this Congress is English”. And not long after that, the German journal of physiology, “Pflügers Archiv für die gesamte Physiologie des Menschen und der Tiere”, changed its title to “The European Journal of Physiology” and all its contributions are now in English. French journals have not followed suit, but French scientists are increasingly publishing in the English language in British and American journals, for a reason which, in one sense is a good reason but in another sense is lamentable, namely that they find that if they publish in French, their articles do not get read — they are read to some extent in Britain but very little in the United States. It is true that there are local journals in almost every language, but these are mostly the proceedings of local societies usually consisting of preliminary communications, and the full reports of the work are published in English. But there are two large parts of the world where these changes have not taken place, namely the USSR and China. In the USSR there has been, and I suspect there still is, an insistence

that any scientist shall first publish a piece of work in the Russian language in a Russian journal. I hope this is less strong in these days of perestroika, but there are still very few papers from the USSR appearing in Western journals. Nowadays, at any rate in my own field, most of these Russian-language journals are translated from cover to cover, but this causes delay and extra cost, and later in this lecture I shall say more about the lack of effectiveness of these translations.

From language I will move on to political factors that are obstacles to supranationalism in science. The one that I find most depressing is the fact that UNESCO, a body devoted to internationalism, has supported the comprehensive boycott of the Republic of South Africa by the United Nations. UNESCO discourages academics throughout the world from having contacts with South Africans, and urges organizers of international scientific meetings to exclude anyone from South Africa from taking part. And many countries have refused to grant entry visas to scientists coming from South Africa. Now UNESCO ought to be the body *par excellence* that encourages international co-operation; I feel this personally because the first Director-General of UNESCO was my half-brother Julian Huxley, and I am sure he would have been horrified by this action on the part of UNESCO. They have subordinated the ideal of internationalism to doing everything possible to harm the Republic of South

Africa because of its policy of apartheid. I sincerely hope that this will change with the progressive liberalization that is now taking place, to the surprise of all of us, in South Africa.

The other most important international body concerned with science is the International Council of Scientific Unions, a non-governmental body. It consists primarily of the Unions which exist for each branch of science, and there are also national members which are the countries whose contributions provide the funds on which ICSU is able to operate. Its policy in relation to South Africa is diametrically opposite to that of UNESCO: it insists that any scientific meeting under ICSU auspices shall be open to all bona fide scientists “without regard to race, religion, political philosophy, ethnic origin, citizenship, language or sex”. On several occasions, an international meeting held under the auspices of ICSU has been moved away from the country where it was originally intended to be held to another country because the originally planned country refused to admit representatives or participants from South Africa. This is an ironic situation because the two examples that I know of resulted in the meeting being moved to a country with a less good record on human rights than the originally intended country: one meeting was moved from Norway to East Germany, the other was moved from Japan to China.

Recently, many countries have met the letter but not

the spirit of these resolutions of the International Council of Scientific Unions in the following way. They have been ready to grant visas for South African scientists coming to attend an international scientific meeting if, but only if, it is being held under the auspices of ICSU or one of its component Unions. For this reason, my own Union, the International Union of Physiological Sciences, of which I am President at the present time, has taken under its wing one or two scientific meetings planned by non-ICSU bodies in order that South African scientists should be enabled to attend. More recently, some countries, including I believe India, have been ready to grant visas on the condition that the participant shall sign a statement denouncing the policy of apartheid. This may allow people to attend but it does not meet fully the requirement by the International Council of Scientific Unions that there should be no discrimination on political grounds. The International Congress of Physiological Sciences that followed the one in Munich that I mentioned was held here in Delhi in 1974, and on that occasion there was nearly a crisis. At that time, India did not grant visas to South Africans, and another matter was that the People's Republic of China said that it would not allow mainland Chinese to attend the Congress if anyone came from Taiwan. In the end, the crisis was averted because no one applied to attend this meeting either from the Republic of South Africa or from Taiwan.

Another occasion where the matter of admission of South African scientists nearly caused a crisis was at the time of the last Congress of my Union, held in Helsinki in 1989. At the time of each of these Congresses, satellite meetings are commonly held in neighbouring countries; a meeting of this character was to be held in Norway but there was a prospect that it would have to be cancelled because at that time Norway refused to grant visas to persons from South Africa under any terms whatever. Fortunately, this problem was resolved by ICSU, which has a Committee on the Free Circulation of Scientists. The Secretary of that Committee is an energetic and knowledgeable Swede, and he was already aware of two relevant points. One was that all the Scandinavian countries had a common policy about giving visas to South Africans, and the second was that his own country, Sweden, was willing to grant visas to South African scientists in order to attend meetings held by Unions that were members of ICSU. It should have followed from these two facts that the Norwegian Government would, in the same way as Sweden, grant visas to South Africans wishing to attend this satellite meeting. He looked into the matter and discovered an extraordinary situation. As he had surmised, the Norwegian law did allow visas to be granted, but almost nobody in Norway knew this fact, and indeed, as I mentioned, a year or two previously an ICSU meeting had been moved from Norway to East Germany

because visas had been refused. But this Secretary of the Committee discovered that even within the Norwegian Foreign Office this bit of Norwegian law was known in the legal department but not in other departments; in particular it was not known in the department that issued visas. After this representation from ICSU the visa difficulty was removed. But even more depressing was the threat that the local students' union would not allow the residences to be used unless South Africans were excluded; this problem was resolved, I believe, by accommodating the participants in hotels instead, and in the end the meeting was held successfully.

Lest you should imagine that it is because of any sort of sympathy with the policy of apartheid in South Africa that I am speaking against the exclusion of South Africans, I will tell you of a very different situation in which I was involved. In 1982, when I was President of the Royal Society, I had occasion to send a strongly-worded telegram of protest to the Government of Australia because they had refused admission to two very senior Russian scientists, one of them a Vice-President of the USSR Academy of Sciences, who had intended to take part in the International Congress of Biochemistry at Perth in Western Australia. This was at the time of the war in Afghanistan and the Australian Government was operating this restriction by way of protest against this action by the USSR.

Even more depressing than these government restrictions on free circulation are the occasions when academics themselves have created obstacles. This did happen in Britain —I am ashamed to say — a few years ago when a so-called World Archaeological Congress was to be held in Southampton. Participants from South Africa had been invited, but in the end they were dis-invited, and this applied not only to South African citizens but also to others who happened to be in South Africa at the time and wished to come from that country. This was the result of threefold pressure. First, the city authority threatened to withdraw its subsidy to the Congress. Second, students refused to allow student accommodation to be used. But worst of all, the local branch of the Association of University Teachers decided to boycott the meeting unless South Africans were excluded. Well, the organizers gave in, claiming that as a result of excluding South African scientists they had many more participants from developing countries, especially in Africa, than would otherwise have been the case. I do not know whether if I had been in the same position I would have had the strength of mind to hold out in favour of free circulation of scientists.

My general feeling on this matter of participation by South Africans is that there is no justification for using science as a weapon in political conflicts of this kind. For one thing, its effectiveness as a weapon is probably

negligible: I do not imagine that the South African Government was influenced in any significant degree by the exclusion of South African scientists from these international meetings: indeed, supporters of apartheid may have thought it rather amusing that friends of black South Africa should be creating difficulties for South African academics who are predominantly liberals and active opponents of apartheid. The other side of the coin is that if this weapon were used more widely, although negligible in relation to political objectives, it would be devastating for world science : there must be rather few countries whose record is absolutely clear on matters like race and other aspects of human rights, and if we started discriminating generally, where would we stop? Many regimes are at least as offensive as that of South Africa, and among them I would include the USSR in the days before Gorbachev and perestroika, on account of its refusal to allow its citizens, particularly Jews, to emigrate.

Another probably less important obstacle to internationalism is publication of journals which are in some way restricted to a particular nation. Some journals of scientific academies accept only papers submitted by a member : this is true of the "Proceedings of the National Academy of Sciences of the USA," and until very recently it was true of the journals of the Royal Society. However, this is not a very important matter because there are always alternative journals available which are

open to publication by scientists from any country. But a rather different and interesting case arose a few years ago in relation to the weekly journal, “Nature”, published in Britain and with a very high reputation throughout the world. Letters appeared in “Nature” lamenting that the proportion of letters and short articles coming from Great Britain had dropped dramatically and this was taken as an indication of a decline in British science. I looked into this myself, going through many issues of “Nature” and counting up where the letters had come from. It was indeed true that the proportion of articles from Britain had dropped greatly and the proportion from the United States had shot up. But this coincided with the date at which “Nature” opened an editorial office in New York: “Nature” has this high international repute, American scientists in great numbers began to submit their best work to “Nature”, and it was impossible to resist the huge pressure of top quality work that came from there. Another interesting thing that I found — rather depressing from your point of view — is that before this influx of high - quality papers from the States began, there was a very substantial proportion of letters and short articles from India, Africa, South America and other parts of the world where science is less highly developed, but this flow dried up almost completely after the competition from first-class work in the United States developed. This seems to me an example of another common phenomenon:

all of us are in favour of equal opportunity, but here, as in many other contexts, equal opportunity leads to unrestrained competition and the weakest get pushed out.

Another kind of barrier is explicit nationalism in science. I am glad to say that it is very rare but there have been notable examples, the best known and probably the most serious being the ascendancy that Lysenko was able to obtain over genetics in the USSR. Mendelism — well established experimentally since the turn of the century — and Western genetics generally, were denounced as bourgeois and anti-Soviet. Mendelian geneticists were removed from their posts or met even worse fates: the most distinguished of pre-war geneticists in the USSR, Vavilov, was put into concentration camps and died in one of them in 1944. A parallel though much less well known situation arose also in my own subject, physiology. Lysenko had re-established his ascendancy over other forms of genetics by organizing a joint meeting of the USSR Academy of Sciences with the Academy of Agricultural Sciences of the USSR. And in a closely parallel way in 1950 a joint meeting of the USSR Academy of Sciences with the Academy of Medical Sciences was organized by Bykov, a well-known physiologist in the USSR, who succeeded in establishing that the “correct” form of physiology was one that followed principles established by I.P. Pavlov, admittedly one of the greatest physiologists of the early part of this century, and Bykov

created an opposition between Pavlovian physiology and western "bourgeois" physiology. In consequence, physiologists were removed from important centres such as Moscow and Leningrad and were sent as far as Siberia, though I do not think that any perished in concentration camps. This purge fortunately came to an end with Stalin's death.

All my previous examples have been single occasional events. Perhaps, however, the most serious barriers to international co-operation between scientists are subconscious ones which operate all the time. The following is an example. Analysis of the references given at the end of scientific papers, carried out by the Institute of Scientific Information in the United States, has shown that in general any particular scientific paper is referred to very much more often in papers published in the same country than in papers published in other countries. No doubt, this is to some extent a consequence of scientists personally knowing of work in their own country through contact with the individuals concerned and through local scientific meetings. Another factor is that different aspects of a subject are fashionable in different countries at different times, so that there is usually a greater amount of relevant work in the same country. But the existence of these different fashions does lead to disregard of good work performed in other countries. I mentioned earlier that all the major Russian journals in physiology are fully

translated and re-published in English. But in spite of that it has to be admitted that Russian physiology is not well known in the United States or Britain. It is true that these journals contain many rather mediocre papers: with the present-day bulk of publications even in one's own speciality, it is impossible to keep up with everything that one ought to read, and if scientists do not expect to benefit from ploughing through a particular journal they do not take the trouble to do so. For this sort of reason, physiologists in the West will rarely search journals from the USSR to find if there is anything particularly interesting, and, I think, this is generally true in biology, but not in some of the physical sciences where Russian work, for instance in mathematics, mechanics and cosmology, is very highly regarded in the West and original work does get picked up. But in biology the result is that when an interesting discovery is made in the USSR it very often does not get widely known until it has been re-discovered independently in the West, and often it is the re-discoverer who is given the credit. I have in mind several such examples in my own field.

In almost all respects, this is a deplorable situation, but there is at least one redeeming feature. The existence of these national fashions in biology does mean that every now and then an important experiment that is done, perhaps in the USSR, is of a kind that no scientist in the West would think of doing because it would have seemed

to him that there was no prospect of obtaining an interesting result. But every now and again this expectation turns out to be wrong. There is perhaps an analogy in this with Darwinian evolution, where some degree of isolation of an incipient species is often necessary for it to develop differently from its relatives in adjacent areas. I have mentioned two examples of the reaction in the USSR against Western science after World War II. A third was a denial of the cell theory. It was widely stated that a new cell could form itself from the debris of a cell that has been broken up. And with this idea in mind, a Russian physiologist, Studitsky, surgically dissected out a muscle from a rat, minced it up into small pieces so as to destroy every muscle cell present, and reinserted this mince in the place where the muscle had been taken from. The animal was allowed to recover and live for some weeks, and, sure enough, a new muscle was formed from the mince. This was totally contrary to any Western expectation at that time: every muscle cell was certainly destroyed and a negative outcome would have seemed so certain that no one in the West would have attempted the experiment. The explanation for the result came a little later. It was discovered that every muscle contains not only fully developed muscle cells which are very large and therefore easily destroyed by coarse mincing, but also small embryonic cells which are there in order to restore the muscle after injury, and many of these would not be

destroyed by mincing. These hidden embryonic cells divide and combine together to form new muscle, and that is undoubtedly what happened in this experiment. It was of course not what the Russian thought but, as I said, the experiment would never have been done in the West.

Another example where I really do not know the rights and wrongs from the scientific point of view is that in the 1950s many experiments were done in the USSR in which nucleic acid, the genetic material, from one animal was separated chemically and injected into another somewhat different animal of the same species. It was claimed that certain characters of the donor animal were inherited by the offspring of the recipient animal, a process called “transduction”. This again was totally contrary to Western ideas, and at the time it was met with disbelief in the West and was totally disregarded: it was not imaginable that injected nucleic acid could be incorporated into the nucleus of an ovum or sperm. Nowadays, however, many methods are known by which a result of this kind can be achieved. I have no idea whether this was indeed happening in these experiments in the USSR so that the experiments were really valid, or whether there was, in fact, so much variability in the animals used that the experimenters were misled into thinking that “transduction” had occurred. These experiments have not been repeated in recent years since the possibility of transferring DNA into another cell became known.

Another example is in China, where there is a great

deal of experimental work relating to acupuncture and the mechanism by which it can reduce pain. This would not have been done in the West some years ago, though it is being taken up now. In India, those who work on Yoga and trance states are getting interesting results in experiments which would not have been attempted in the West. I am sure there are many other examples: probably many of you will be able to think of parallel cases, perhaps not only in biology.

I have spent most of my time discussing failures to live up to the ideal according to which science pays no regard to national boundaries. But I would not like to leave you imagining that these are typical situations. Throughout my scientific life I have found all my colleagues doing their best to achieve this ideal, by acknowledging contributions from abroad and by discussing their results freely with other scientists not only of their own but of other countries. As regards the cases where the ideal has not been attained, I mentioned them because there are probably analogies in other fields and perhaps discussing them may help people more closely connected with international activity than I am now, to eliminate the parallel obstacles in other aspects of human life. But these cases where this ideal has not been attained, I am glad to say, have usually been situations outside the control of the actual scientists who were involved.

19 March 1991

Sir Andrew Huxley